

XFEL Beam Physics

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- Specify a 1st stage bunch compressor assuming a 250 MeV beam from a 1.3 GHz rf linac with an active length of 24-meters with an initial Gaussian bunch with 10A peak current in 100 pC with 10 keV uncorrelated energy spread. Assume the gradient can be varied to maintain 250 MeV while changing the linac rf phase.
 - a. What R56 is needed to allow over-compression of the bunch to 50A with a maximum phase offset of 30 degrees
 - b. What is the maximum peak current that can be generated? What is the corresponding uncorrelated energy spread?
 - c. What rf phases are needed to compress to 50A and 100A undercompressing?
 - d. Specify a 3rd harmonic system at 3.9 GHz to compensate the 2nd-order terms.



- Calculate the rf phases need to compensate the longitudinal wakefield along a uniform bunch of 100 pC and current of 1kA in 1) a SLAC S-band linac at 20 MV/m and 2) a TESLA 1.3 GHz linac at 15 MV/m.
- Calculate the longitudinal RW for a bunch of 1kA with 100 and 300 pC in a round vacuum chamber with 1 cm radius made of 1) stainless-steel and 2) copper.
- Estimate the energy deviation induced by LSC through the 2km LCLS-II Bypass line assuming a 1 kA beam with a 1% modulation of the beam current at 0.1 um and a 150 um rms beam size.
- 5. Estimate the emittance dilution in a SLAC-type laser heater.